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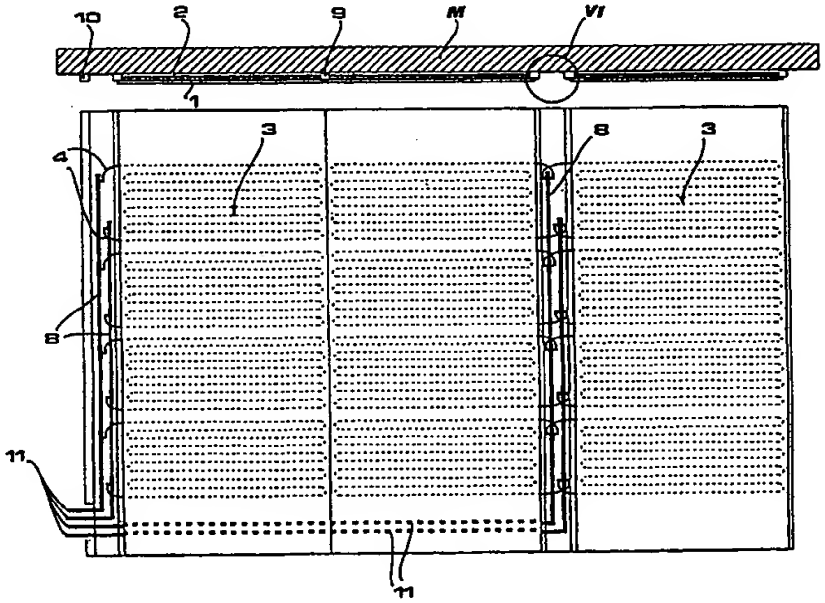

(57) Abstract

A prefabricated, self–supporting, modular radiating panel with a sandwich structure comprises a layer of plasterboard and a layer of heat–insulating material. The plasterboard layer incorporates, internally, several continuous pipes which are designed to form independent hydraulic circuits and the end portions of which emerge in a rear and lateral zone of the panel. Said independent hydraulic circuits are each housed in adjacent modular zones of the panel, said zones being separable from one another so as to provide panel parts of different sizes in a modular manner.

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SELF-SUPPORTING, MODULAR, PREFABRICATED RADIATING PANEL

* = * = * = * =

The present invention relates to a prefabricated, self-supporting, modular radiating panel, and in particular to a panel of this type used for forming radiating surfaces, such as, for example, walls and ceilings, in conditioning systems for rooms. The invention also relates to methods for manufacturing said radiating panel and to a radiating surface formed with a plurality of these panels.

For many years plasterboard panels have been known and regarded as extremely versatile elements for forming false ceilings and dividing walls in both newly constructed and already existing buildings. These panels combine properties of good structural solidity, lightness and an optimum finish of the external surface and therefore may be successfully used for fast and clean operations since all traditional masonry work involving the use of mortar, bricks, plaster and the like may be eliminated entirely. These panels are therefore used with particular advantage for work involving the maintenance or modernisation of existing buildings since installation thereof requires very brief interruption in the use of the buildings themselves and does not cause deterioration of the furnishings which have already been installed therein.

In recent years plasterboard panels have found a new and very interesting use in the manufacture of radiating panels designed to form radiating surface conditioning systems for rooms, in particular in existing building structures, said systems, as is well-known, being characterized by a degree of ambient comfort which is much greater than that of traditional air-conditioning systems and therefore generating a growing interest in the market.

The manufacture of said radiating panels involve the association, on one side of the plasterboard panels, of a coiled piping for circulation of the thermal carrier fluid. The association of the coiled piping with the plasterboard panel is currently performed using two different techniques. A first technique involves milling, at the factory, of the rear side of the panels, insertion of the coiled piping into the milled areas and finally plastering over in order to fix the piping in position and improve the heat exchange between piping and panel. A second technique, which can be used instead on-site, involves fixing with adhesives, to the front side of the panel, a piping already pre-formed with a predefined configuration and plastering the panel with cement mortar or gypsum plaster.

The radiating panel structures described above already represent a considerable step forwards compared to the known prior art which envisaged, by way of alternative, the formation of radiating panels using traditional masonry techniques (EP-A-340,825; EP-A-511,645; EP-A-770,827) which therefore cannot have a practical application in forming room conditioning system in existing buildings, or the use of metal panels (EP-A-366,615; EP-A-452,558; WO 88/06259) which are costly and heavy and moreover are not suitable, from both an aesthetic and a functional point of view, for the formation of radiating surfaces in rooms for residential use.

Moreover, the structures consisting of plasterboard radiating panels as described above have been subject to various major inconveniences which hitherto have constituted a significant obstacle to their widespread use. It should be noted in fact that the radiating panels produced with the first of the techniques described above are seriously weakened by the milling operations involving incision of an external layer thereof and this, during transportation and installation, result in a high percentage of damage (20-30%) due to breakage; moreover, these panels, precisely because they are formed outside of the building site, are quite unflexible from a

constructional point of view since each panel either is supplied in a standard size and therefore gives rise to major problems in terms of applicational adaptability or is made-to-measure for each particular job and therefore, during application, must match exactly the design requirements, thus depriving the installation engineer of any working flexibility and moreover creating considerable difficulties with regard to site management. In this latter case, in fact, supplying of the individual panels cannot be performed in a random manner, but must be carefully planned and executed, strictly in keeping with the progress of the panel installation work itself. The radiating panels made using the second abovementioned technique obviously do not have these drawbacks, but instead have the major disadvantage that they require plastering with cement mortar or with gypsum plaster on-site, thus eliminating one of the essential advantages of this type of product, namely that of allowing "clean" installation in an existing building structure where the furnishings are already in place.

The object of the present invention is therefore that of providing a plasterboard-based radiating panel which avoids the problems and the drawbacks mentioned above and which in particular has a high structural strength and rigidity and allows installation with a finished surface without the use of mortar or plaster so as to be suitable also for installation in existing buildings.

Another object of the present invention is that of providing a plasterboard radiating panel of the abovementioned type which does not have the drawbacks of applicational unflexibility associated with the known panels but which allows, using a single standard factory size, very flexible modular application in the individual installations, thus avoiding both the need to produce panels which are made-to-measure for the particular job in question and the drawback of complicated logistical management with regard to supplying of the panels on-site.

A further object of the present invention is that of providing a radiating panel which is very easy to assemble, from both a mechanical and a hydraulic point of view, so as to allow correct and fast application also by workers who are not particularly specialised.

These objects are achieved according to the present invention by means of a prefabricated, self-supporting, radiating panel with a sandwich structure, characterized in that said sandwich structure comprises a layer of plasterboard and a layer of heat-insulating material and in that the plasterboard layer is provided, internally, with at least one continuous pipe which is designed to form a hydraulic circuit and the end portions of which emerge from the panel.

According to an important feature of the panel, said plasterboard layer comprises a plurality of said continuous pipes each housed in adjacent modular zones of the panel, said zones being separable from one another so as to provide panel parts of different sizes in a modular manner.

Further features and advantages of the present invention will emerge, however, more clearly from the detailed description which follows of preferred embodiments thereof, illustrated in the accompanying drawings, in which:

Fig. 1 is a front elevation view of a radiating panel according to the present invention;

Fig. 2 is a rear elevation view of the panel according to Fig. 1;

Fig. 3 is a partial sectioned view, on a larger scale, along the line III-III of Fig. 1, of a first embodiment of the panel;

Fig. 4 is a view, similar to that of Fig. 3, of a second embodiment of the panel;

Fig. 5 is a front elevation and plan view illustrating the mechanical fixing and hydraulic assembly of a plurality of radiating panels according to the present invention which are arranged adjacent to one another so as to

form a radiating surface;

Fig. 6A is a enlarged detail of the encircled zone VI in Fig. 5;

Fig. 6B is a plan view of solely the Ω-shaped metal support section according to Fig. 6A; and

Figs. 7 and 10 show a corresponding number of front elevation views of the different stages of assembly of a radiating wall according to the present invention, on a pre-existing masonry structure with windows.

With reference to Figs. 1-5, each radiating panel P according to the present invention comprises an external layer of plasterboard 1 and an internal layer of heat insulating material 2. The plasterboard layer 1 may have, in an economically advantageous manner, a traditional sandwich structure consisting of two external sheets of cardboard and an internal gypsum core, or other structures known per se, for example one in which the reinforcing fibre is for example distributed in a uniform manner inside the gypsum matrix; the insulating layer 2 preferably consists of an expanded or extruded heat insulating material such as, for example, polystyrene, polyurethane, glass wool and the like.

The plasterboard layer 1 has, embedded internally, a plurality of continuous pipes 3 which each form an independent hydraulic circuit, the end portions 4 of which emerge laterally in the back from the panel P. The pipes 3 preferably have a circular cross-section and are arranged along a coiled path as illustrated in the drawings, it also being possible to use any other arrangement or shape of said pipes according to the invention. More precisely, as can be seen in Figs. 2, 5 and 6A, the dimensions of the plasterboard layer 1 are slightly greater than those of the insulating layer 2, both laterally, in order to leave side strips 1f of the plasterboard layer 1 exposed for mechanical fixing of said layer and for emergence of the end portions 4 of the pipes 3, and at the top and the bottom, wh re zones 5 of the layer 1 are left exposed especially so as to allow housing of the main

pipes for the supply and return flow of the thermal carrier fluid, as will be described in greater detail below. The abovementioned arrangement of the end portions 4 and the zones 5 facilitates considerably, as we shall see, standardisation of the production and the hydraulic connection of the individual circuits, also allowing the formation of a continuous external surface of plasterboard with an optimum finish.

Each coiled pipe 3 extends exclusively inside only one of several adjacent zones 6 which form the panel P, without there being, therefore, any overlapping with the adjacent pipes. The perimeter of the zones 6, indicated by parallel broken lines L in Fig. 1, is preferably also physically highlighted on the surface of the panel P using any method useful for this purpose, such as scoring or colouring obtained by means of silk-screen printing, adhesive strips and the like. The top and bottom end zones 5 of the panel P are completely free from both the coiled pipes 3 inside the plasterboard layer 1 and, as has already been seen, the heat insulating layer 2.

The insertion of the coiled pipes 3 inside the plasterboard layer 1 may be performed using two different manufacturing methods. The first method may be applied with success both to large-size and medium or small-size production since it requires only a minimum amount of plant equipment and uses materials which are normally available on the market. The starting material in fact consists of standard panels of insulating material and standard plasterboard panels. Several coil-shaped cavities 7 are milled in one side of the plasterboard panel and a corresponding pipe 3 is then arranged in each of them so as to form an independent hydraulic circuit. Alternately and in a preferred manner, the pipes inserted into the cavities 7 are in the form of a single pipe which emerges from the panel at the end of each cavity 7 and enters back into it at the start of the next cavity (Figs. 1 and 2); in this way it is sufficient to close off the two ends of the overall

pipes 3 in order to avoid the undesirable introduction of foreign or contaminated material into the piping during transportation and installation of the panel. At the time when hydraulic connection is performed, the pipe 3 is cut at points corresponding to the end of each hydraulic circuit, as shown in Fig. 1, and is then connected to supply headers, as will be explained more clearly below.

This manufacturing method is illustrated in Fig. 3, where cavities 7 with U-shaped cross-sections are shown; other cross-sectional shapes are obviously possible so as to match more closely the cross-sectional shape of the pipes 3. Once the pipes 3 have been inserted, the cavities 7 are filled and plastered with gypsum plaster or with a suitable heat-conducting cement and then the plasterboard layer 1 is ready for joining to the heat insulating layer 2 which is cut to the desired size from the standard insulating panels which are available on the market. This joining operation is performed by means of gluing using methods which are well-known in the art and produces finally the panel P which is ready for installation.

A second manufacturing method, on the other hand, may be applied only to large-scale production, being directly integrated within the process for the manufacture of plasterboard panels. In this second method, in fact, the coiled pipes 3 are inserted into the plasterboard layer 1 during the formation of the gypsum core, so as to be incorporated within it, as schematically illustrated in the cross-sectional view according to Fig. 4. Compared to the above first method, on account of greater industrialisation of this process it is possible to achieve with the same advantageous economies of scale.

A substantial advantage of the first manufacturing method, moreover, is that of its immediate applicability, since it does not require any modification of the current industrial methods of manufacturing plasterboard panels - said modification, on the contrary, being necessary in the second

manufacturing method according to the present invention - nor the setting-up of complex production plants. On the other hand, the present invention brilliantly overcomes the single drawback associated with the use of commercially available plasterboard panels, namely the drawback already discussed above and consisting in the reduction of the mechanical strength of the plasterboard panel as a result of the fact that one of the two cardboard sheets undergoes milling and therefore loses part of its reinforcing function. This drawback is in fact completely overcome, according to the present invention, precisely as a result of joining together of the plasterboard layer 1 and the heat insulating layer 2, which joining operation, in addition to achieving the necessary thermal insulation of the pipes 3, produces a new reinforcing sandwich effect which amply offsets the loss of mechanical strength due to the milling of one of the cardboard sheets of the plasterboard layer 1, thus rendering the panel according to the present invention completely self-supporting. It is obviously preferable, in this first manufacturing method, to use a material which has good mechanical properties, such as polystyrene for example, as the material for the heat insulating layer 2.

The pipes 3 may be made equally well of plastic or metallic material. In the first manufacturing method, plastic pipes are preferably used since they can be inserted more easily and quickly inside the milled areas, in particular if the latter are performed using manual or semi-automatic site equipment and therefore do not reproduce exactly a predefined pattern. Metal pipes, and in particular stainless steel pipes, are instead preferred for use in the second method of manufacturing the panels and may also be used in the first method, but only where the milling is performed by fully automatic machines.

Metal pipes obviously have the advantage, compared to pipes made of plastic, that they facilitate considerably the subsequent execution of

holes in the wall for furnishing requirements, both because they can be easily detected using a normal metal detector and because they have a sufficiently high mechanical strength to withstand the perforating action of a simple nail, provided that the latter is struck with a certain degree of care. However, stainless steel pipes have a much higher cost than plastic pipes which are therefore always preferred when cost is a decisive factor in the application.

In order to be able to determine the location of said pipes inside the wall and therefore be able to perform the desired boring operations without the risk of damaging the pipes themselves, heat-sensitive liquid crystal sheets from some time have been available on the market, said sheets being placed on the wall and revealing, by means of a different colour, the presence of the pipes on the basis of their different temperature compared to that of the surrounding wall. This method, however, cannot be used as easily and quickly as a metal detector since it necessarily requires activation of the system and lapsing of a certain amount of time before the differences in temperature become evident on the surface of the wall. According to the present invention, it is proposed instead using plastic pipes which incorporate, inside their plastic wall, a thin continuous metal wire which is sufficient to allow detection of the piping with a metal detector. Since the metal wire is incorporated in the plastic and therefore is not subject to any stress, it may be made with a fineness such that it has a negligible cost and does not reduce in any way the flexibility of the plastic pipe.

Assembly of the panels P in order to form a radiating surface according to the present invention is performed in an extremely simple manner, both from the mechanical point of view, namely as regards fixing of the panels to the pre-existing masonry walls or ceilings, and from the point of view of the hydraulic connection of the individual pipes 3 to the main lines supplying the thermal carrier fluid.

In this radiating surface, the panels P according to the pr sent invention are in fact arranged in pairs - respectively in the position illustrated in Fig. 1 and a position rotated planewise through 180° - along the wall or the ceiling to be lined, in the manner illustrated in Fig. 5, namely so that they are adjacent along the sides without the end portions 4, and are separated by a predetermined distance, sufficient to allow insertion of secondary headers 8, along the sides provided with end portions 4. For faster and easier assembly, the arrangement of the zones 5 and 6 inside the panel P is preferably symmetrical with respect to a middle axis of the panel, parallel to the lines L, such that in the region of the headers 8 the end portions 4 of two adjacent panels are all levelled. In practice, in preparing a radiating surface according to the present invention, assembly is performed in four successive steps, shown in Figs. 7 to 10. First of all, see Fig. 7, at the joints between adjacent panels, metal support sections 9 with a square or U-shaped cross-section are fixed to the masonry structure M, while metal support sections 10 with an Ω-shaped cross-section are fixed to the wall at the joints between panels located at a distance from one another, said sections therefore being arranged alternately with respect to the sections 9 and their width determining the distance between pairs of non-adjacent panels. Once the sections 9 and 10 have been fixed onto the masonry structure M to be lined - with an interval between sections 9 and flanges of the sections 10 which is identical to the width of the panels P - the installation engineer then installs the main lines 11 supplying the thermal carrier fluid, which are housed in the top or bottom end zones 5 of the panels, as well as the secondary headers 8 which, as already mentioned, are housed inside the Ω-shaped sections 10. This assembly step is illustrated in Fig. 8.

The lines 11 and the headers 8 may be made using one of the many techniques available today. For faster and easier assembly, plastic pipes

and fast snap-action unions are obviously preferred since they avoid having to perform heat-welding operations which are awkward and difficult to perform, in particular in the case of ceiling applications. A sheet of heat-insulating material 12 is preferably arranged between the end wall of the Ω-shaped section 10 and the supporting masonry structure M (see Fig. 6B), so as to prevent any dispersion of heat towards said masonry structure by the headers 8. Alternatively, these pipes may be of the type which are independently insulated as is the case, preferably, for the lines 11. Finally, where necessary and in an entirely traditional manner, heat insulating panels may be inserted in the zones 5 which are not used for housing the lines 11.

After arranging the pipes 8 and 11 in position, the installation engineer is able to perform fixing and hydraulic connection of the panels P (Figs. 9 and 6A). Said panels are fixed mechanically on one side to the sections 9 and on the other side to the flanges of the sections 10, in an entirely traditional manner, while the end portions 4 of the coiled pipes 3 are connected to the supply and return headers 8m and 8r by means of the abovementioned fast-action unions. As illustrated in Fig. 6A, the end portions 4 pass through the flanges of the Ω-shaped section 10 via special openings provided opposite each pair of end portions 4 and, after being cut to size, are connected to the corresponding supply headers 8m and return headers 8r.

Finally, as illustrated in Fig. 10, covering panels C consisting of plasterboard alone are fixed onto the said sections 9 and 10 so as to obtain a continuous finished surface of the radiating wall, which is ready for application of the final coat of paint.

According to an important characteristic feature of the present invention, the panel P is produced in a single standard size and adaptation to the individual installation requirements is achieved with xtreme simplicity, by simply "splitting" the panel along the dividing lines L between

adjacent zones 6. In the embodiment shown the panel P has dimensions of 120x270 cm and th individual zones 6 have a height of 45 cm and are separated by a distance of 8 cm free from pipes; other measurements ar obviously possible, depending on the standard sizes of the panels available on the market and the number of zones 6 formed in the individual panel. In this way, owing to the complete separation and independence of th individual circuits formed by the coiled pipes 3, it is possible to obtain rapidly and easily panels P both of limited height, by eliminating one or more zones 6 from a standard panel, as occurs for example in the zones underneath windows shown in Figs. 9 and 10, as well as panels of greater height, as may occur in stairwells and the like, by adding one or more zones 6, taken from one panel, to another panel P.

This type of operation obviously does not result in any reject material since any individual surplus panel zones 6 can always be mounted on top of one another so as to form a whole panel P, without having to vary in any way the fixing system which is based on the sections 9 and 10 and on the headers 8 described above. A simple plastering operation performed over the joints between panels P or individual zones 6 of panels adjacent to one another will allow one to eliminate all external signs of the composite arrangement used to achieve the formation of the final wall. It goes without saying that the peripheral zones for joining to the surrounding walls of the radiating-panel wall thus formed may consist of ordinary plasterboard panels G which are suitably shaped, in the case where, owing to the dimensions of the wall to be lined or the irregular nature of its perimeter, this is advisable or also simply more convenient, or when the planned size of the radiating surface has been reached.

The modular arrangement of the pipes 3, and hence their formation into independent hydraulic circuits, also results in another considerable advantage during operation of the radiating surface. In fact, the circuit

geometry used allows a significant reduction in the overall head losses in the individual hydraulic circuit and consequently a low "ΔT" value between the supply and return of the thermal carrier fluid. This ensures a high degree of uniformity of surface heat which is an essential requirement for obtaining a high radiating exchange with the environment, in particular in the case of cool summer conditions where the working temperature of the panel must never be lower than the dew-point temperature of the ambient air.

From the above description it should therefore be extremely clear how the prefabricated radiating panel according to the present invention has fully achieved the preset objects of the invention.

On the one hand, in fact, owing to the sandwich combination of the plasterboard layer with the insulating layer, the panel according to the present invention has an excellent mechanical strength during storage, transportation and installation operations, so as to reduce considerably the risk of damage to the material during these operations. On the other hand, owing to the modular structure of the individual conditioning circuits formed by the coiled pipes, both a high degree of flexibility during installation and a complete standardisation of production is achieved. The modular nature of the panels, finally, also allows easy and advantageous partial recycling of the panels themselves in the event of damage during the transportation and assembly operations. Finally the panel according to the present invention greatly facilitates both the mechanical and the hydraulic installation operations and avoids the need for any traditional masonry work since the final surface of the radiating wall formed by said panels is already able to receive the final coat of filler and paint.

The radiating panel according to the present invention has been described with reference to particular embodiments thereof, but it is obvious that various modifications may be made thereto, for example in the

form and in the arrangement of the zones 5 or 6, in the distribution of the coiled pipes 3, and in the arrangement or type of end portions 4, without thereby departing from the protective scope of the present invention, as defined in the accompanying claims.

CLAIMS

1. Prefabricated, self-supporting, radiating panel with a sandwich structure, characterized in that said sandwich structure comprises a layer of plasterboard and a layer of heat-insulating material and in that the plasterboard layer incorporates, internally, at least one continuous pipe which is designed to form a hydraulic circuit and the end portions of which emerge from the panel.

2. Radiating panel as claimed in Claim 1, wherein said plasterboard layer comprises a plurality of said continuous pipes each housed in adjacent modular zones of the panel, said zones being separable from one another so as to provide panel parts of different sizes in a modular manner.

3. Radiating panel as claimed in Claim 2, wherein said pipes have a coiled arrangement and said end portions emerge from the panel in a rear and lateral zone thereof.

4. Radiating panel as claimed in Claim 2, wherein said modular zones have a symmetrical arrangement with respect to a middle axis of the panel.

5. Radiating panel as claimed in Claim 4, wherein said modular zones extend, arranged above one another, parallel to the short side of the panel.

6. Radiating panel as claimed in Claim 4, wherein the lines separating adjacent modules are highlighted on the external surface of the panel by means of scoring or colouring obtained by means of silk-screen printing, adhesive tapes and the like.

7. Radiating panel as claimed in Claim 3, wherein the width of the heat insulating layer of the panel is less than the width of the plasterboard layer by an amount sufficient to allow said end portions to emerge freely from the plasterboard layer and allow direct fixing of the plasterboard panel

to supporting sections.

8. Radiating panel as claimed in Claim 2, comprising moreover two transverse facing end strips, which are devoid of pipes and insulating layer, for housing the lines supplying the thermal carrier fluid behind the panel.

9. Radiating panel as claimed in Claim 2, wherein said pipe is a pipe made of plastic material.

10. Radiating panel as claimed in Claim 9, wherein said pipe comprises a continuous metal wire incorporated in the wall of the pipe.

11. Radiating panel as claimed in Claim 2, wherein said pipe is a pipe made of metallic material and preferably stainless steel.

12. Radiating panel as claimed in any one of the preceding claims, wherein said layers of the panel are fixed together by means of gluing.

13. Method for manufacturing a radiating panel as claimed in any one of Claims 1 to 12, comprising, during manufacture, the steps of:

a) milling one or more coiled cavities on one side of a plasterboard panel;

b) inserting into said cavities a continuous piping, the end portions of which emerge in a rear lateral zone of said panel;

c) sealing said piping inside said cavity using a heat-conducting sealing material;

d) gluing onto the abovementioned side of the panel a layer of heat insulating material; and, during manufacture or installation, the step of:

e) cutting said piping at the piping lengths connecting one cavity to the adjacent cavity.

14. Method for manufacturing a radiating panel as claimed in any one of Claims 1 to 12, comprising the steps of:

a) forming a plasterboard panel by inserting inside the gypsum core thereof one or more coiled pipes, the end portions of which emerge from a

rear lat ral zone on one sid of said panel;

b) gluing onto the abovementioned side of the panel a layer of heat insulating material.

15. Radiating panel formed by a plurality of panels as claimed in any one of Claims 1 to 12, characterized in that said panels are arranged alongside one another such that pairs of neighbouring panels are adjacent along the sides which do not have the end portions of the pipes and instead are separated from one another, along the sides provided with the said end portions, by a predetermined distance sufficient to allow the insertion, between the panels, of secondary headers which are connected to said end portions.

16. Radiating panel as claimed in Claim 15, which is fixed to pre-existing masonry walls or ceilings by means of interposed metal support sections with a square or U-shaped cross-section along the line joining together adjacent panels and metal support sections with an Ω-shaped cross-section along the strip joining together non-adjacent panels.

17. Radiating panel as claimed in Claim 16, wherein said secondary headers are housed in said metal sections with an Ω-shaped cross-section, where they are connected to said end portions of the coiled pipes.

18. Radiating wall as claimed in Claim 16, which also comprises main supply lines for supplying thermal carrier fluid to said secondary headers, which are housed behind the panels along the strips of said panels which do not have said heat insulating layer.

19. Radiating panel as claimed in Claim 16, also comprising, along said Ω-shaped metal sections, a plasterboard covering panel.

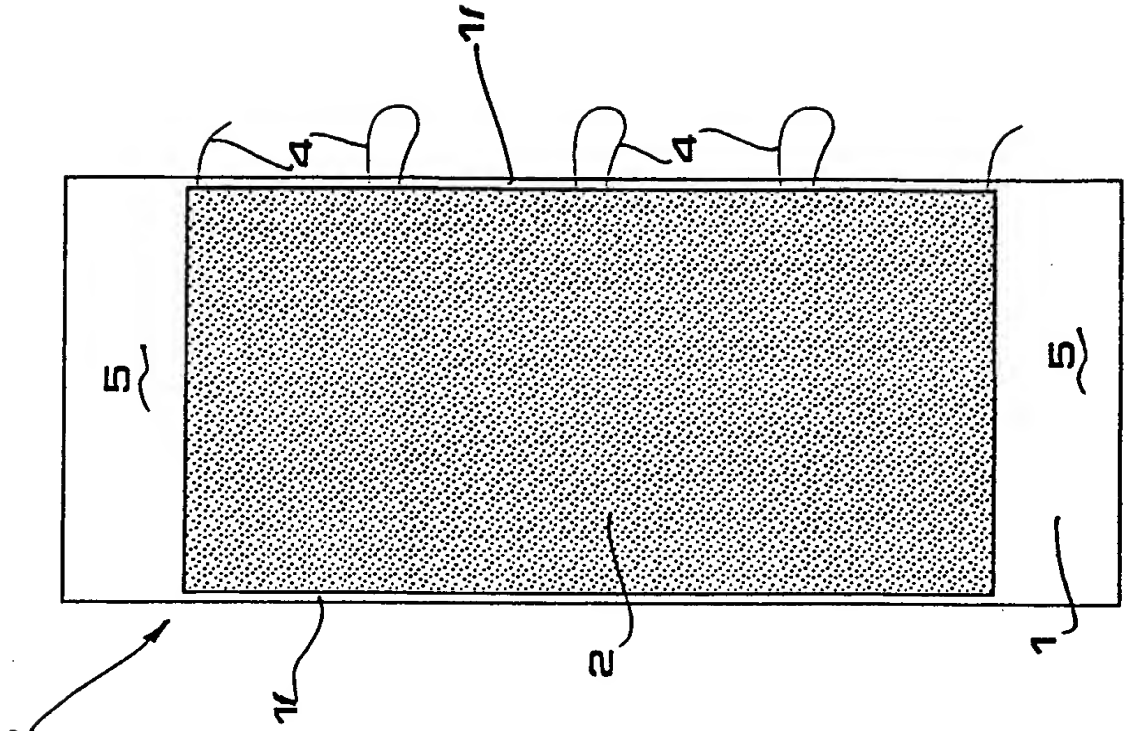


FIG.2

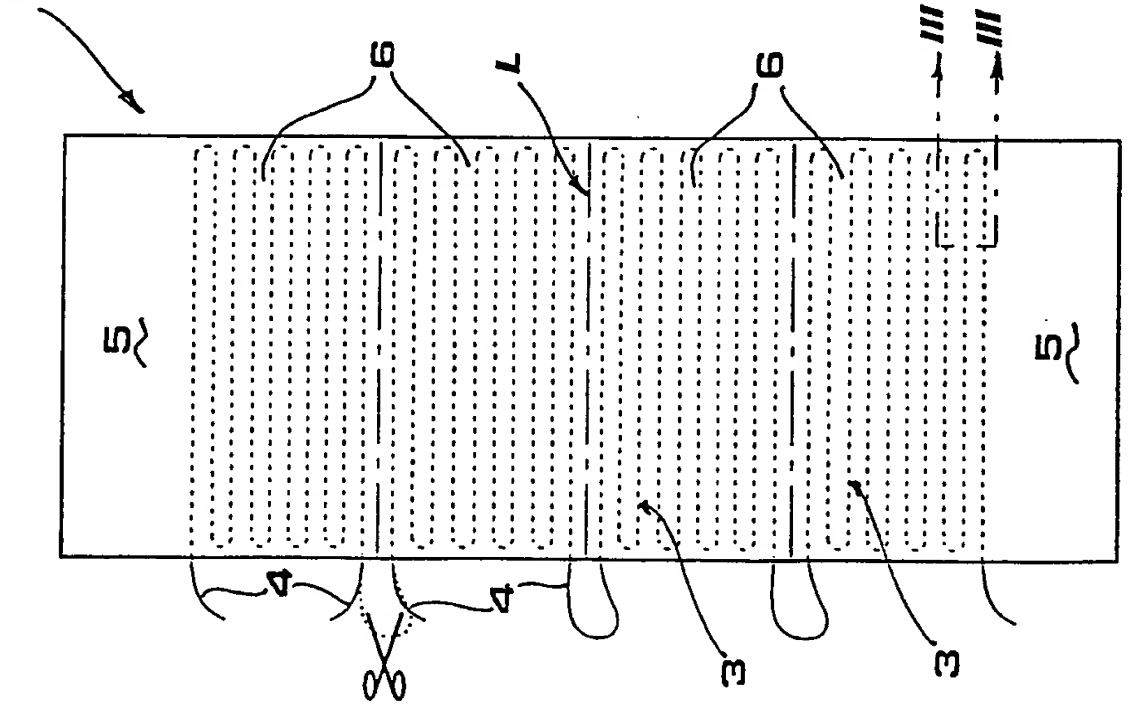


FIG.1

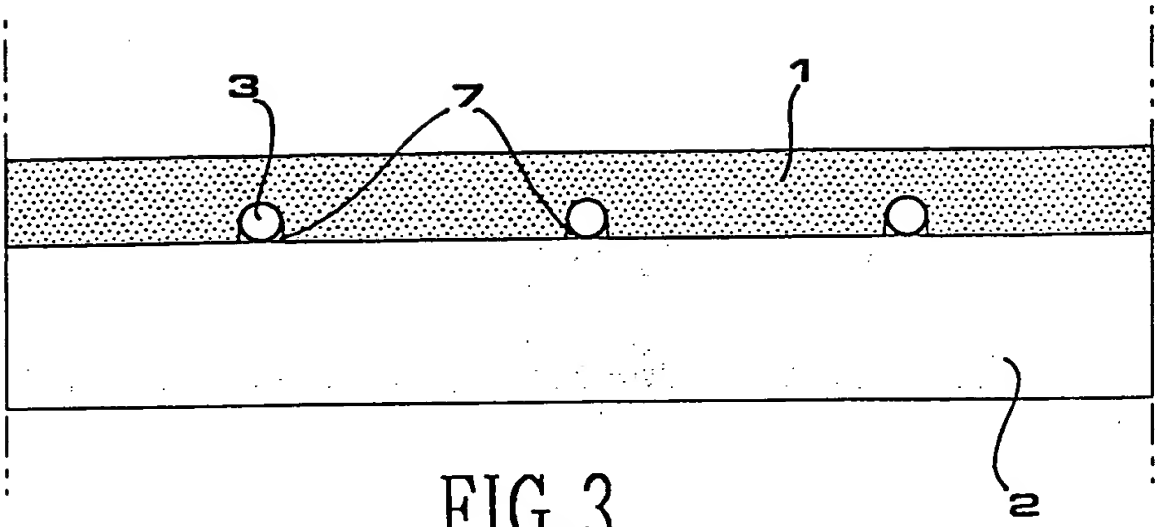


FIG.3

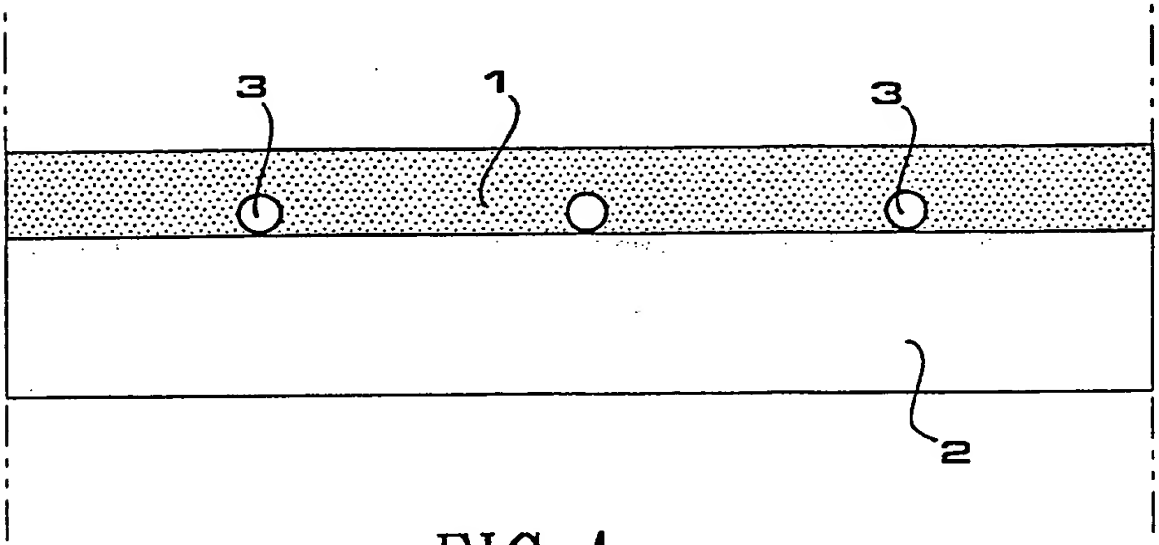
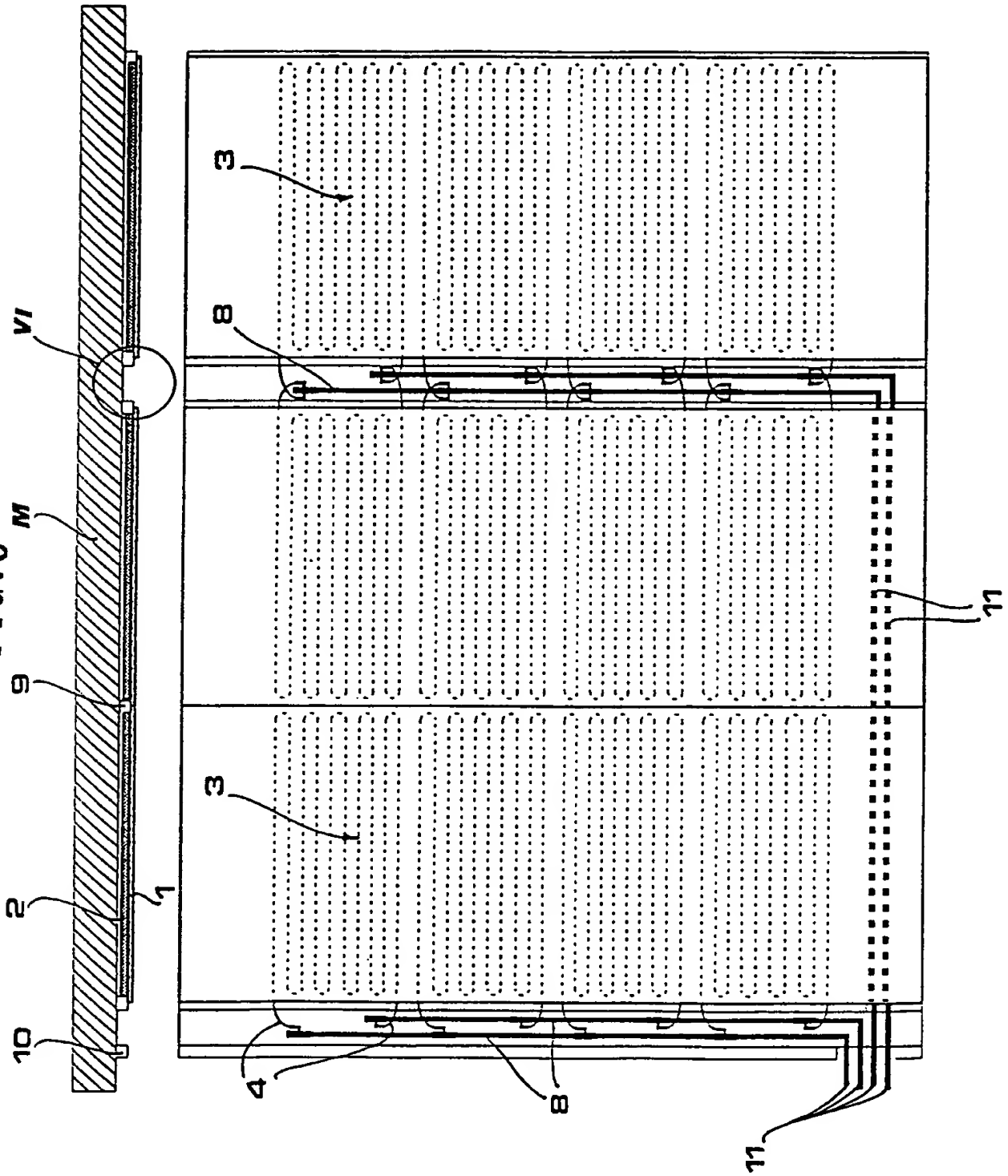


FIG.4

FIG.5



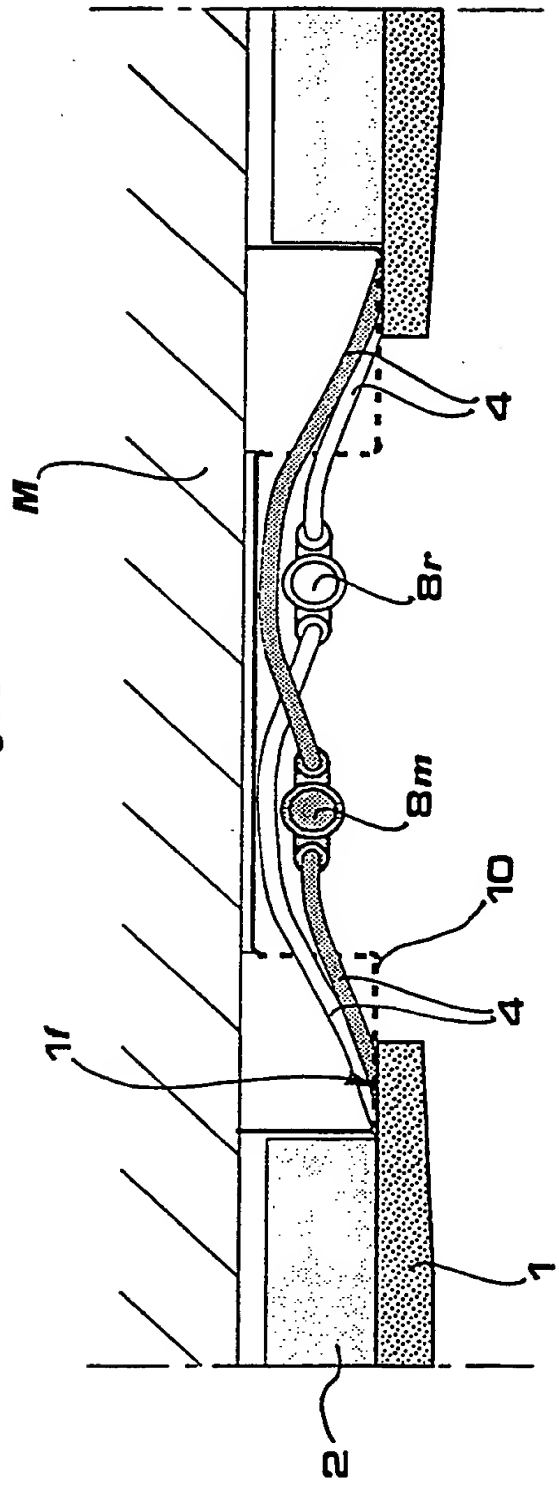


FIG.6A

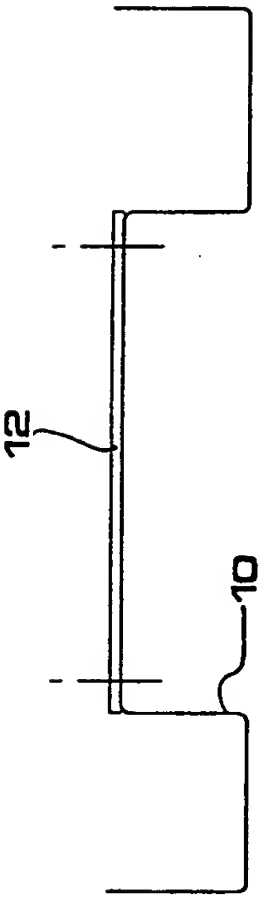


FIG.6B

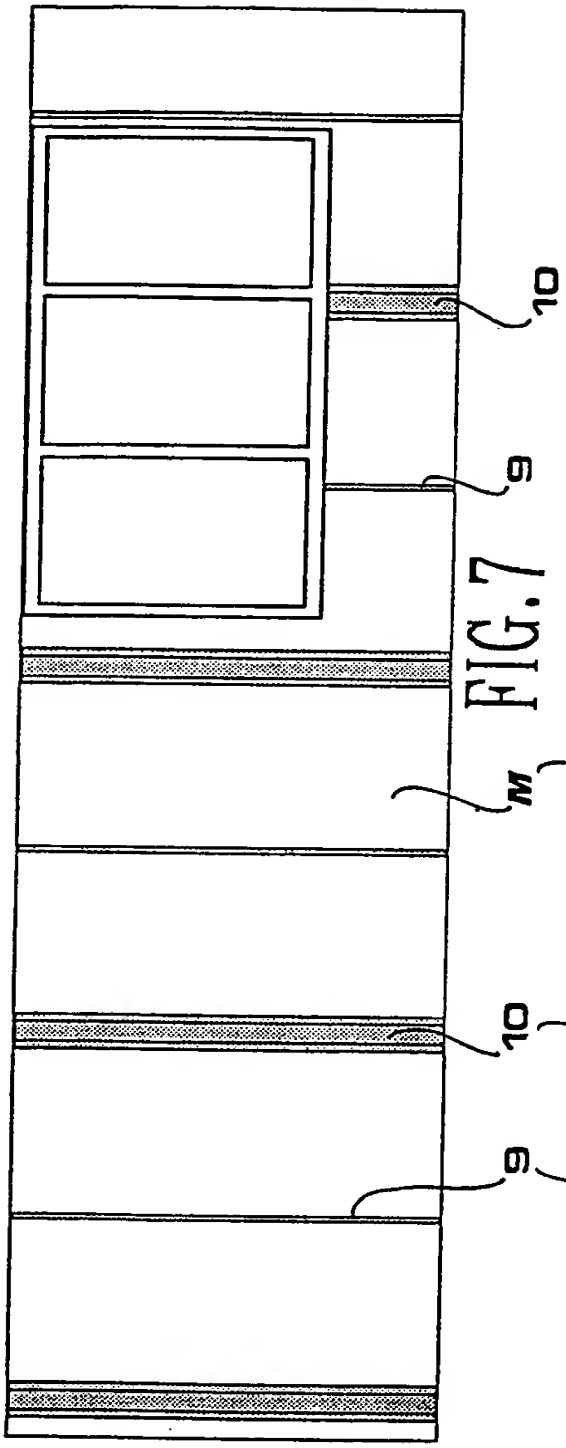


FIG.7

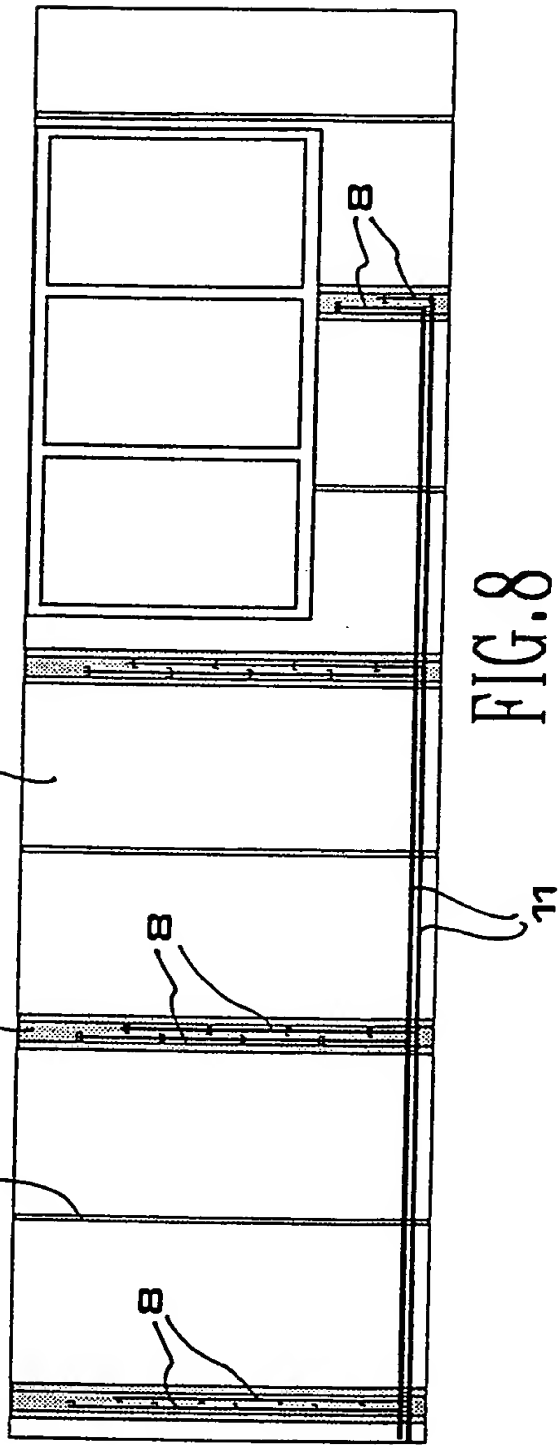


FIG.8

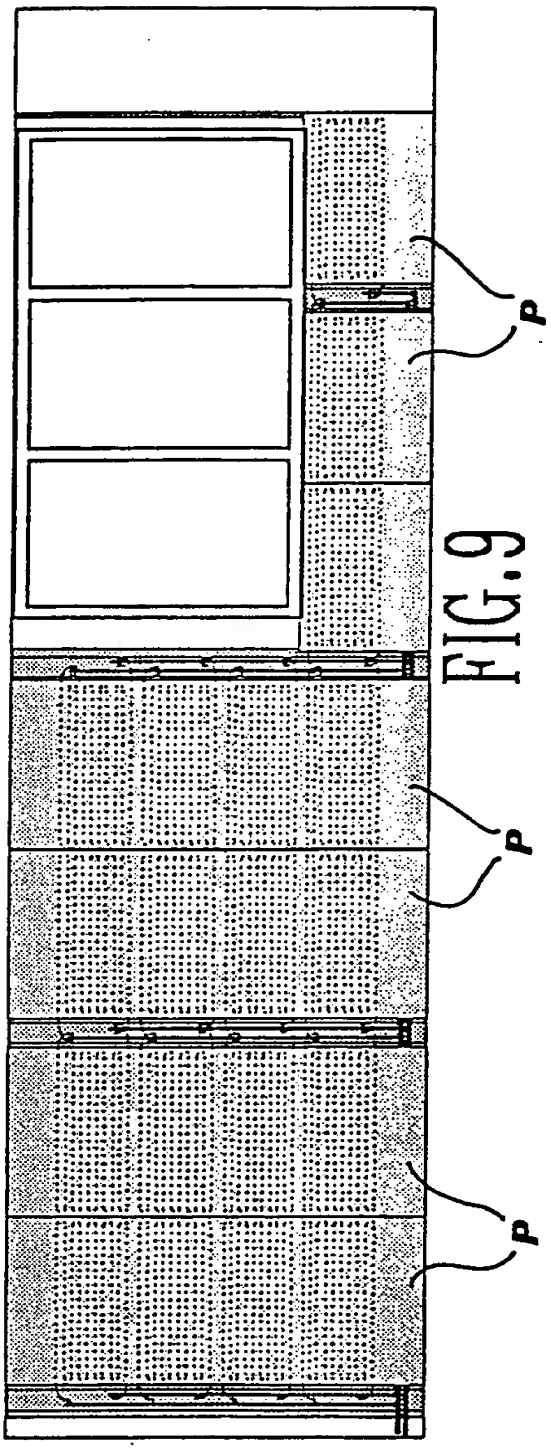


FIG.9

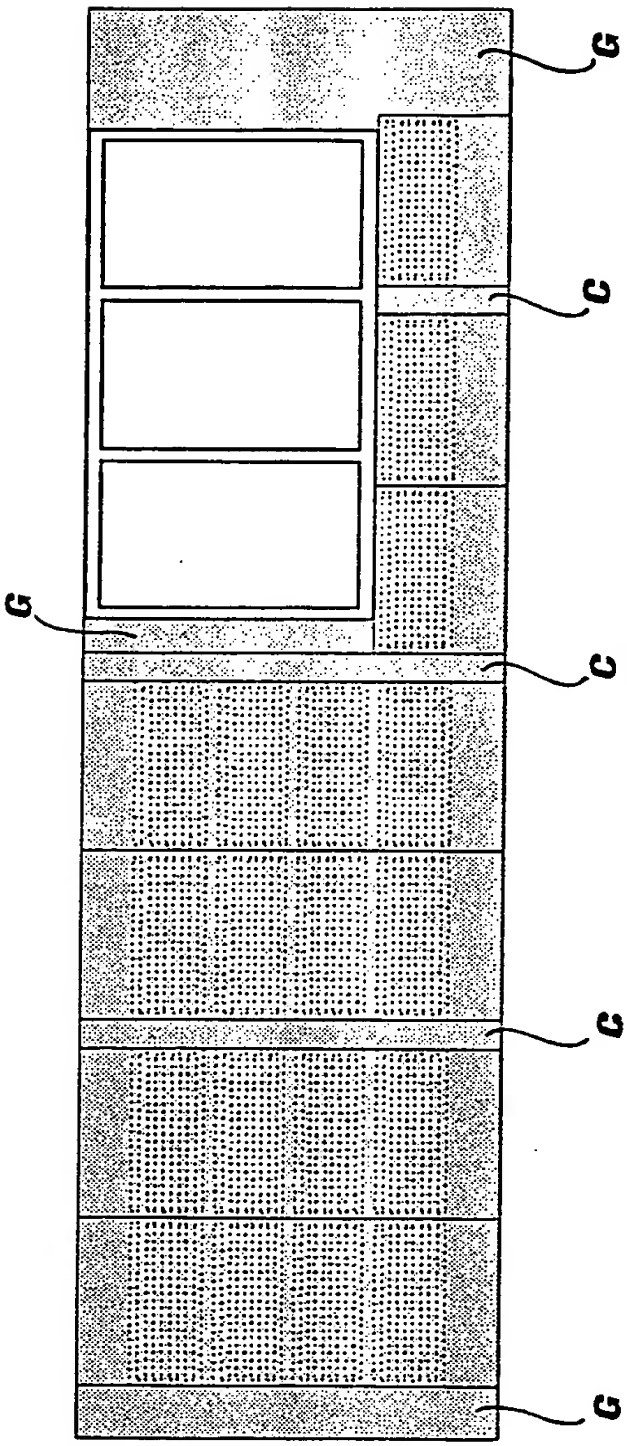


FIG.10

INTERNATIONAL SEARCH REPORT

Inter. Application No
PCT/IB 99/01864

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F24D3/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F24D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 90 12 650 U (SANDLER ENERGIETECHNIK GMBH & CO KG) 8 November 1990 (1990-11-08) claims; figures	1,7,13, 15
A	EP 0 501 470 A (SANDLER ENERGIETECHNIK) 2 September 1992 (1992-09-02) abstract; figures	1,7,13, 15
A	DE 41 37 753 A (KOESTER HELMUT) 19 May 1993 (1993-05-19) abstract	1,13,15

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 March 2000	17/03/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax (+31–70) 340–3016	Van Gestel, H

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. Application No
PCT/IB 99/01864

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 9012650 U	08-11-1990	NONE	
EP 0501470 A	02-09-1992	DE 4106200 A	24-09-1992
		AT 93043 T	15-08-1993
		DE 9116941 U	25-01-1996
DE 4137753 A	19-05-1993	NONE	

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
MF/37829/PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IB99/01864	22/11/1999	23/11/1998
International Patent Classification (IPC) or national classification and IPC F24D3/16		
Applicant PLAN HOLDING GMBH et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21/06/2000	16.03.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Dauvergne, B Telephone No. +49 89 2399 7527

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB99/01864

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1,2,4-14	as originally filed			
3	as received on	21/02/2001	with letter of	09/02/2001

Claims, No.:

1-20	as received on	21/02/2001	with letter of	09/02/2001

Drawings, sheets:

1/6-6/6	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-20
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-20
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-20
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Preamble:

This application is being examined in the European phase under ref. 98 830 703.9.

1- Statement:

Reference is made to the following documents:
D1: DE 41 37 753 A
D2: DE 90 12 650 U

The present application deals with a prefabricated, self-supporting, radiating panel with a sandwich structure, formed a layer of plasterboard and a layer of heat-insulating material. The plasterboard layer incorporates, internally, pipes that have end portions emerging from a side of the panel.

Such panels are known from D1 that furthermore discloses that the pipes can be housed in cavities and arranged in a coiled outline (col.3, lines 23-27). However, the pipes of D1 are meant to be part of the same hydraulic circuit (via Sammelrohre 21, 33). They are not either placed in zones that can be considered as modular, the element of D1 being considered as non evolutive (Fertigplattenbauteil col.1, line 63).

The panel according to the present invention may be adapted on site and thus be manufactured according to industry standard sizes.

The present invention as defined in claim 1 thus fulfills the requirements of novelty and inventive step set by articles 33.2 and 33.3 PCT. Claims 2 to 20 detail further characteristics and embodiments for an apparatus satisfying the requirements of claim 1, for a method to manufacture a panel according to claim 1, or for a wall formed by panels according to claim 1.

2- Further differences with prior art

The radiating panel according to D1 and D2, may comprise two top and bottom end zones (see D1, Fig.1 and D2, claim 7), which are devoid of pipes. However, those are not devoid of insulating layer. Such a feature allows to house the lines supplying the thermal carrier fluid behind the panel.

Claim 13 also reveals a feature, namely that the pipe emerges as a loop at the boundary between adjacent coiled cavities, which is not present in the prior art. The presence of such a loop increases the flexibility of the apparatus in terms of use since the loop can be cut or left untouched according to the length of isolation panel needed.

Re Item VII
Certain defects in the international application

Although claim 1 is drafted in the two-part form the features 'continuous pipes each housed in a coiled outline' are incorrectly placed in the characterising portion, as they are disclosed in document D1 in combination with the features placed in the preamble (Rule 6.3(b) PCT).

Re Item VIII
Certain observations on the international application

1- Claim 16:

Claim 16 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is defined in vague terms. The claim lacks clarity because the attempt is made to define the panel by making reference to the features of the header which does not form part of the panel. Thus, the shape, size and technical features of the panel referred to in this claim are undefined (cf. PCT guidelines III.4.8.a).

TENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT 15

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
MF/37829/PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IB99/01864	22/11/1999	23/11/1998
International Patent Classification (IPC) or national classification and IPC F24D3/16		
Applicant PLAN HOLDING GMBH et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21/06/2000	31.01.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Dauvergne, B Telephone No. +49 89 2399 7527

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB99/01864

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1-14 as originally filed

Claims, No.:

1-19 as originally filed

Drawings, sheets:

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	6-19
	No:	Claims	1-5
Inventive step (IS)	Yes:	Claims	
	No:	Claims	6-19
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:
D1: DE 41 37 753 A
D2: DE 90 12 650 U

1- Novelty

The subject matter of claims 1-5 lacks novelty (Art. 33.2 PCT) because their features are known from D1. Clarity objections are also made in section VIII regarding claim 2-5.

1-1 Claim 1:

From D1 fig.2, a prefabricated, self-supporting, radiating panel with a sandwich structure is known. The structure furthermore comprises a layer of plasterboard (Gibsbauplatte 10, fig.1) and a layer of heat-insulating material (18, fig.2, col.2, lines 59-65).
The plasterboard layer further incorporates, internally, at least one continuous pipe(12-17, fig.1) which is designed to form a hydraulic circuit and the end portions of which emerge from the panel.

1-2 Claims 2, 3, 4, 5:

In the light of the comments relating to the clarity of these claims (see section VIII), the plasterboard layer of the panel described in D1 also comprises a plurality continuous pipes, each housed in adjacent modular zones of the panel, said zones being separable from one another, and having a symmetrical arrangement with respect to a middle axis of the panel.

According to D1, col.3, line 26, the pipes can have a coiled shape.

Given that the panel described in D1 does not have specific dimensional limitations, the 'modular zones' (see section VIII) can extend, arranged above one another, parallel to the short side of the panel

2- Inventive step

The subject matter of claims 6-9, 11-19 would appear to lack an inventive step (Art. 33.3 PCT) for the following reasons:

2-1 Claim 6:

Signalling lines separating adjacent elements by highlighting a surface by means of scoring or colouring is not new. Such a practice is common in the art of construction. It would thus appear obvious to the skilled person wanting to signal that special care or a particular treatment, such as cutting, has to be applied along that line.

2-2 Claims 7, 8:

The apparatus disclosed in D1, fig.4, shows a width of the heat insulating layer of the panel less than the width of the plasterboard layer by an amount sufficient to allow said end portions to emerge freely from the plasterboard layer. This provides the apparatus with transverse end strips, which are devoid of pipes and insulating layer, for housing the lines supplying the thermal carrier fluid behind the panel. This furthermore allows direct fixing of the plasterboard panel to supporting sections.

2-3 Claims 9, 10, 11, 12:

The use of plastic material or of metallic material for the pipe, the gluing of materials are merely one of several straightforward possibilities that the skilled person would select, in order to solve the problem posed, that is to conduct water inside a panel without leaks.

The incorporation of a metal wire in the pipe in order to facilitate detection with a metal detector is one of the obvious solutions that could use the skilled person

2-4 Claims 13, 14:

Taking in account D1, fig.1, 2, col 3, lines 18-30, it appears that the manufacturing methods proposed in claims 13, 14 are only one of several straightforward possibilities that the skilled person would select in order to manufacture the apparatus. Furthermore, the

insertion of the pipes inside the gypsum is already disclosed in D2, fig.1.

2-5 Claims 15, 16, 17, 18, 19:

Claims 15-19 merely describe obvious mounting methods, inspired from isolation panels mounting techniques with aluminium profiles, adapted to the apparatus described in D1 and D2.

Re Item VII
Certain defects in the international application

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D2 is not mentioned in the description, nor is this document identified therein.

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII
Certain observations on the international application

1- Claims 2, 3, 4, 5:

Claims 2, 3, 4, 5 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is defined in vague terms. In particular, the words modular and module have no precise definition in the description. It is therefore assumed that a module is in fact a zone 6, as shown on figure 1. In any case, the apparatus disclosed in D1 can also be cut or separated in several sub-modules and be fully operational. Such an apparatus can thus be considered as modular.

2- Claim 8:

Claim 8 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is defined in vague terms. In particular, the words 'transverse facing end strips' are not present in the description, not pointed at in a drawing that could give

them a precise meaning. It was thus assumed that those were the side strips 1f, description page 5, line 26.

3- Claim 15:

Claim 15 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is defined in vague terms. The claim lacks clarity because the attempt is made to define the panel by making reference to the features of the header which does not form part of the panel. Thus, the shape, size and technical features of the panel referred to in this claim are undefined (cf. PCT guidelines III.4.8.a).

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
MF/37829/PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IB99/01864	22/11/1999	23/11/1998
International Patent Classification (IPC) or national classification and IPC F24D3/16		
Applicant PLAN HOLDING GMBH et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

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   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

CORRECTED VERSION

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21/06/2000	16.03.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Dauvergne, B Telephone No. +49 89 2399 7527

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB99/01864

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1,2,4-14	as originally filed			
3	as received on	21/02/2001	with letter of	09/02/2001

Claims, No.:

1-20	as received on	21/02/2001	with letter of	09/02/2001

Drawings, sheets:

1/6-6/6	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-20
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-20
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-20
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

R Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step r industrial applicability; citations and explanations supporting such statement

Preamble:

This application is being examined in the European phase under ref. 98 830 703.9.

1- Statement:

Reference is made to the following documents:
D1: DE 41 37 753 A
D2: DE 90 12 650 U

The present application deals with a prefabricated, self-supporting, radiating panel with a sandwich structure, formed a layer of plasterboard and a layer of heat-insulating material. The plasterboard layer incorporates, internally, pipes that have end portions emerging from a side of the panel.

Such panels are known from D1 that furthermore discloses that the pipes can be housed in cavities and arranged in a coiled outline (col.3, lines 23-27). However, the pipes of D1 are meant to be part of the same hydraulic circuit (via Sammelrohre 21, 33). They are not either placed in zones that can be considered as modular, the element of D1 being considered as non evolutive (Fertigplattenbauteil col.1, line 63).

The panel according to the present invention may be adapted on site and thus be manufactured according to industry standard sizes.

The present invention as defined in claim 1 thus fulfills the requirements of novelty and inventive step set by articles 33.2 and 33.3 PCT. Claims 2 to 20 detail further characteristics and embodiments for an apparatus satisfying the requirements of claim 1, for a method to manufacture a panel according to claim 1, or for a wall formed by panels according to claim 1.

2- Further differ nces with prior art

The radiating panel according to D1 and D2, may comprise two top and bottom end zones (see D1, Fig.1 and D2, claim 7), which are devoid of pipes. However, those are not devoid of insulating layer. Such a feature allows to house the lines supplying the thermal carrier fluid behind the panel.

Claim 13 also reveals a feature, namely that the pipe emerges as a loop at the boundary between adjacent coiled cavities, which is not present in the prior art. The presenc of such a loop increases the flexibility of the apparatus in terms of use since the loop can be cut or left untouched according to the length of isolation panel needed.

Re Item VII

Certain defects in the international application

Although claim 1 is drafted in the two-part form the features 'continuous pipes each housed in a coiled outline' are incorrectly placed in the characterising portion, as they are disclosed in document D1 in combination with the features placed in the preamble (Rule 6.3(b) PCT).

Re Item VIII

Certain observations on the international application

1- Claim 16:

Claim 16 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is defined in vague terms. The claim lacks clarity because the attempt is made to define the panel by making reference to the features of the header which does not form part of the panel. Thus, the shape, size and technical features of the panel referred to in this claim are undefined (cf. PCT guidelines III.4.8.a).

constructional point of view since each panel either is supplied in a standard size and therefore gives rise to major problems in terms of applicational adaptability or is made-to-measure for each particular job and therefore, during application, must match exactly the design requirements, thus depriving the installation engineer of any working flexibility and moreover creating considerable difficulties with regard to site management. In this latter case, in fact, supplying of the individual panels cannot be performed in a random manner, but must be carefully planned and executed, strictly in keeping with the progress of the panel installation work itself. The radiating panels made using the second abovementioned technique obviously do not have these drawbacks, but instead have the major disadvantage that they require plastering with cement mortar or with gypsum plaster on-site, thus eliminating one of the essential advantages of this type of product, namely that of allowing "clean" installation in an existing building structure where the furnishings are already in place. DE-A-4137753 discloses a radiating panel in which a plurality of parallel capillary pipes are embedded in a plasterboard and connected at their opposed end to respective headers included in the panel structure. DE-U-9012650 discloses fixing systems for radiating panels.

The object of the present invention is therefore that of providing a plasterboard-based radiating panel which avoids the problems and the drawbacks mentioned above and which in particular has a high structural strength and rigidity and allows installation with a finished surface without the use of mortar or plaster so as to be suitable also for installation in existing buildings.

Another object of the present invention is that of providing a plasterboard radiating panel of the abovementioned type which does not have the drawbacks of applicational unflexibility associated with the known panels but which allows, using a single standard factory size, very flexible modular application in the individual installations, thus avoiding both the need to produce panels which are made-to-measure for the particular job in question and the drawback of complicated logistical management with regard to supplying of the panels on-site.

CLAIMS

1. Prefabricated, self-supporting, radiating panel (P) having a sandwich structure formed by at least a layer of plasterboard (1) and a layer of heat-insulating material (2), said plasterboard layer (1) incorporating, internally, pipes (3) for a working fluid, the end portions of which emerge from a side of the panel, characterized in that said plasterboard layer (1) comprises a plurality of continuous pipes (3) each housed in cavities arranged in a coiled outline on one side and in adjacent modular zones (6) of the panel and forming an independent hydraulic circuit, said zones (6) being separable from one another so as to provide panel parts of different sizes in a modular manner.

2. Radiating panel as claimed in Claim 1, wherein the end portions (4) of each of said independent hydraulic circuits emerge laterally from the panel (P), in a rear zone thereof, at a long edge of the panel.

3. Radiating panel as in Claim 1, wherein said zones (6) have all the same area and house all the same length of said pipe (3).

4. Radiating panel as claimed in Claim 2, wherein said modular zones (6) have a symmetrical arrangement with respect to a middle axis of the panel.

5. Radiating panel as claimed in Claim 4, wherein said modular zones (6) extend, arranged above one another, parallel to the short side of the panel (P).

6. Radiating panel as claimed in Claim 4, wherein the lines (L) separating adjacent modules are highlighted on the external surface of the panel (P) by means of scoring or colouring obtained by means of silk-screen printing, adhesive tapes and the like.

7. Radiating panel as claimed in Claim 3, wherein the width of the heat insulating layer (2) of the panel is less than the width of the plasterboard (1) by an amount sufficient to allow said end portions (4) to emerge freely from the plasterboard layer (1) and allow direct fixing of the plasterboard panel (P) to supporting sections (9, 10).

8. Radiating panel as claimed in Claim 2, comprising moreover two top and bottom end zones (5), which are devoid of pipes (3) and insulating layer (2), for housing the lines (11) supplying the thermal carrier fluid behind the panel (P).

9. Radiating panel as claimed in Claim 2, wherein said pipe (3) is a pipe made of

plastic material.

10. Radiating panel as claimed in Claim 9, wherein said pipe (3) comprises a continuous metal wire incorporated in the wall of the pipe.

11. Radiating panel as claimed in Claim 2, wherein said pipe (3) is a pipe made of metallic material and preferably stainless steel.

12. Radiating panel as claimed in any one of the preceding claims, wherein said layers (1, 2) of the panel are fixed together by means of gluing.

13. Method for manufacturing a radiating panel as claimed in any one of Claims 1 to 12, of the type comprising, during manufacture, the steps in succession of:

a) milling one or more cavities (7) on one side of a plasterboard panel (1);

b) inserting pipes (3) into said cavities (7);

c) gluing onto the abovementioned side of the panel a layer (2) of heat insulating material;

characterised in that it further comprises, during manufacture, the following steps:

a1) forming said cavities (7) with a coiled arrangement, the two ends of each coiled cavity opening at one and the same side of the panel (P);

b1) forming said pipes (3) as only one continuos pipe, said continuos pipe emerging from said side of the panel, as a free end at the bottom and the top of the panel and as a loop at the boundary between adjacent coiled cavities;

d) sealing said continuos pipe (3) inside said cavity using a heat-conducting sealing material;

and in that, during manufacture or installation, further comprises the step of:

e) cutting said continuos pipe (3) at the loops thereof connecting adjacent coiled cavities.

14. Method for manufacturing a radiating panel as claimed in any one of Claims 1 to 12, comprising the steps of:

a) forming a plasterboard panel by inserting inside the gypsum core thereof one or more coiled pipes (3), the end portions of which emerge from one side of said panel;

b) gluing onto one side of the panel a layer (2) of heat insulating material.

15. Method for manufacturing a radiating panel as claimed in any one of Claims 1 to 12, comprising the steps of:

a) forming a plasterboard panel by inserting inside the gypsum core thereof only one continuos pipe (3), formed in more than one coils, said continuos pipe emerging from said side of the panel, as a free end at the bottom and the top of the panel and as a loop at the boundary between adjacent coils;

b) gluing onto one side of the panel a layer (2) of heat insulating material.

16. Radiating wall formed by a plurality of panels as claimed in any one of Claims 1 to 12, characterized in that said panels (P) are arranged alongside one another such that pairs of neighbouring panels (P) are adjacent along the sides which do not have the end portions (4) of the pipes (3) and instead are separated from one another, along the sides provided with the said end portions (4), by a predetermined distance sufficient to allow the insertion, between the panels, of secondary headers (8) which are connected to said end portions (4).

17. Radiating wall as claimed in Claim 16, which is fixed to pre-existing masonry walls or ceilings by means of interposed metal support sections with a square or U-shaped cross-section (9) along the line joining together adjacent panels and metal support sections with an Ω-shaped cross-section (10) along the strip joining together non-adjacent panels.

18. Radiating wall as claimed in Claim 17, wherein said secondary headers (8) are housed in said metal sections with an Ω-shaped cross-section (10), where they are connected to said end portions (4) of the coiled pipes (3).

19. Radiating wall as claimed in Claim 17, which also comprises main supply lines (11) for supplying thermal carrier fluid to said secondary headers (8), which are housed behind the panels (P) along the strips (5) of said panels which do not have said heat insulating layer (5).

20. Radiating wall as claimed in Claim 17, also comprising, along said Ω-shaped metal sections, a plasterboard covering panel (C).

constructional point of view since each panel either is supplied in a standard size and therefore gives rise to major problems in terms of applicational adaptability or is made-to-measure for each particular job and therefore, during application, must match exactly the design requirements, thus depriving the installation engineer of any working flexibility and moreover creating considerable difficulties with regard to site management. In this latter case, in fact, supplying of the individual panels cannot be performed in a random manner, but must be carefully planned and executed, strictly in keeping with the progress of the panel installation work itself. The radiating panels made using the second abovementioned technique obviously do not have these drawbacks, but instead have the major disadvantage that they require plastering with cement mortar or with gypsum plaster on-site, thus eliminating one of the essential advantages of this type of product, namely that of allowing "clean" installation in an existing building structure where the furnishings are already in place. DE-A-4137753 discloses a radiating panel in which a plurality of parallel capillary pipes are embedded in a plasterboard and connected at their opposed end to respective headers included in the panel structure. DE-U-9012650 discloses fixing systems for radiating panels.

The object of the present invention is therefore that of providing a plasterboard-based radiating panel which avoids the problems and the drawbacks mentioned above and which in particular has a high structural strength and rigidity and allows installation with a finished surface without the use of mortar or plaster so as to be suitable also for installation in existing buildings.

Another object of the present invention is that of providing a plasterboard radiating panel of the abovementioned type which does not have the drawbacks of applicational unflexibility associated with the known panels but which allows, using a single standard factory size, very flexible modular application in the individual installations, thus avoiding both the need to produce panels which are made-to-measure for the particular job in question and the drawback of complicated logistical management with regard to supplying of the panels on-site.

CLAIMS

1. Prefabricated, self-supporting, radiating panel (P) having a sandwich structure formed by at least a layer of plasterboard (1) and a layer of heat-insulating material (2), said plasterboard layer (1) incorporating, internally, pipes (3) for a working fluid, the end portions of which emerge from a side of the panel, characterized in that said plasterboard layer (1) comprises a plurality of continuous pipes (3) each housed in cavities arranged in a coiled outline on one side and in adjacent modular zones (6) of the panel and forming an independent hydraulic circuit, said zones (6) being separable from one another so as to provide panel parts of different sizes in a modular manner.

2. Radiating panel as claimed in Claim 1, wherein the end portions (4) of each of said independent hydraulic circuits emerge laterally from the panel (P), in a rear zone thereof, at a long edge of the panel.

3. Radiating panel as in Claim 1, wherein said zones (6) have all the same area and house all the same length of said pipe (3).

4. Radiating panel as claimed in Claim 2, wherein said modular zones (6) have a symmetrical arrangement with respect to a middle axis of the panel.

5. Radiating panel as claimed in Claim 4, wherein said modular zones (6) extend, arranged above one another, parallel to the short side of the panel (P).

6. Radiating panel as claimed in Claim 4, wherein the lines (L) separating adjacent modules are highlighted on the external surface of the panel (P) by means of scoring or colouring obtained by means of silk-screen printing, adhesive tapes and the like.

7. Radiating panel as claimed in Claim 3, wherein the width of the heat insulating layer (2) of the panel is less than the width of the plasterboard (1) by an amount sufficient to allow said end portions (4) to emerge freely from the plasterboard layer (1) and allow direct fixing of the plasterboard panel (P) to supporting sections (9, 10).

8. Radiating panel as claimed in Claim 2, comprising moreover two top and bottom end zones (5), which are devoid of pipes (3) and insulating layer (2), for housing the lines (11) supplying the thermal carrier fluid behind the panel (P).

9. Radiating panel as claimed in Claim 2, wherein said pipe (3) is a pipe made of

plastic material.

10. Radiating panel as claimed in Claim 9, wherein said pipe (3) comprises a continuous metal wire incorporated in the wall of the pipe.

11. Radiating panel as claimed in Claim 2, wherein said pipe (3) is a pipe made of metallic material and preferably stainless steel.

Sub. A1.

12. Radiating panel as claimed in any one of the preceding claims, wherein said layers (1, 2) of the panel are fixed together by means of gluing.

13. Method for manufacturing a radiating panel as claimed in any one of Claims 1 to 12, of the type comprising, during manufacture, the steps in succession of:

a) milling one or more cavities (7) on one side of a plasterboard panel (1);

b) inserting pipes (3) into said cavities (7);

c) gluing onto the abovementioned side of the panel a layer (2) of heat insulating material;

characterised in that it further comprises, during manufacture, the following steps:

a1) forming said cavities (7) with a coiled arrangement, the two ends of each coiled cavity opening at one and the same side of the panel (P);

b1) forming said pipes (3) as only one continuos pipe, said continuos pipe emerging from said side of the panel, as a free end at the bottom and the top of the panel and as a loop at the boundary between adjacent coiled cavities;

d) sealing said continuos pipe (3) inside said cavity using a heat-conducting sealing material;

and in that, during manufacture or installation, further comprises the step of:

e) cutting said continuos pipe (3) at the loops thereof connecting adjacent coiled cavities.

14. Method for manufacturing a radiating panel as claimed in any one of Claims 1 to 12, comprising the steps of:

a) forming a plasterboard panel by inserting inside the gypsum core thereof one or more coiled pipes (3), the end portions of which emerge from one side of said panel;

b) gluing onto one side of the panel a layer (2) of heat insulating material.

15. Method for manufacturing a radiating panel as claimed in any one of Claims 1 to 12, comprising the steps of:

a) forming a plasterboard panel by inserting inside the gypsum core thereof only one continuos pipe (3), formed in more than one coils, said continuos pipe emerging from said side of the panel, as a free end at the bottom and the top of the panel and as a loop at the boundary between adjacent coils;

b) gluing onto one side of the panel a layer (2) of heat insulating material.

16. Radiating wall formed by a plurality of panels as claimed in any one of Claims 1 to 12, characterized in that said panels (P) are arranged alongside one another such that pairs of neighbouring panels (P) are adjacent along the sides which do not have the end portions (4) of the pipes (3) and instead are separated from one another, along the sides provided with the said end portions (4), by a predetermined distance sufficient to allow the insertion, between the panels, of secondary headers (8) which are connected to said end portions (4).

17. Radiating wall as claimed in Claim 16, which is fixed to pre-existing masonry walls or ceilings by means of interposed metal support sections with a square or U-shaped cross-section (9) along the line joining together adjacent panels and metal support sections with an Ω-shaped cross-section (10) along the strip joining together non-adjacent panels.

18. Radiating wall as claimed in Claim 17, wherein said secondary headers (8) are housed in said metal sections with an Ω-shaped cross-section (10), where they are connected to said end portions (4) of the coiled pipes (3).

19. Radiating wall as claimed in Claim 17, which also comprises main supply lines (11) for supplying thermal carrier fluid to said secondary headers (8), which are housed behind the panels (P) along the strips (5) of said panels which do not have said heat insulating layer (5).

20. Radiating wall as claimed in Claim 17, also comprising, along said Ω-shaped metal sections, a plasterboard covering panel (C).

add B7

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
MF/37829/PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/IB 99/01864	22/11/1999	23/11/1998
Applicant		
PLAN HOLDING GMBH et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

[ ] the text is approved as submitted by the applicant.

[X] the text has been established by this Authority to read as follows:

SELF-SUPPORTING, MODULAR, PREFABRICATED RADIATING PANEL

5. With regard to the **abstract**,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 5

[X] as suggested by the applicant.

[ ] None of the figures.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.